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By N. SENN, M. D.,

MILWAUKEE, WIS.

Read in the Section on Surgery and Anatomy of the American Medical Association, May, 1884.

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ON BRANCHIAL CYSTS OF THE NECK.

The differential diagnosis and operative treatment of tumors of the neck, are subjects which belong to the most imperfect and unsatisfactory topics in surgery. The great difficulties which are often encountered in the diagnosis of cervical tumors, and the importance of the anatomical structures which are involved in all operative procedures for their removal, are well known and appreciated by all who can speak from personal experience. One of the most important, and, at the same time, one of the darkest chapters treating of tumors in this region, relates to cystic tumors, and more particularly that variety which originates from congenital defects of development, the matrix being composed of fœtal epiblastic or hypoblastic tissue, which remains in its embryonal state for an indefinite time, and later, by proliferation of its epithelial elements, gives rise to a distinct and characteristic type of cystic tumors. These tumors have been variously designated as branchial cysts (Roser), dermoid cysts of the sheath of the internal jugular vein (Langenbeck), deep-seated atheromatous tumors (Schede), tumors of the branchial clefts (Virchow), hydrocele colli congenita (Mannoir), hygroma colli (Luschka), atheromatous cysts of lymphatic glands (Luecke), in accordance with the nature of the contents of the tumor, or the peculiar etiological views entertained by different authors. It appears to me, however, that "branchial cysts" is the most appropriate term, as it expresses at once both the location and the character of the tumor.

EMBRYOLOGICAL AND ANATOMICAL REMARKS.

Toward the end of the first month of fœtal life, we see under the frontal process, open in front and bounded on the sides by four plates, the pharyngeal cavity. The upper pair of plates constitute the first branchial arch. The next three pairs of plates make up the second, third, and fourth branchial arches, which decrease in size from above downward, so that their median interspaces in front are narrow above and wider lower down. Between each pair of branchial arches on each side remains a transverse cleft, the branchial clefts, which unite during early fœtal life, with the exception of the first one, from which the external auditory canal, the cavity of the tympanum (middle ear) and the Eustachian tube are developed. The neck is thus built up of continuous lateral walls. From the second branchial arch are developed the styloid process, the stylo-hyoid ligament, the lesser cornua of the hyoid bone; the third arch forms the large horns and the body of this bone; the fourth arch assists in forming the soft tissues of the neck. The larynx, trachea, and adjacent glands are developed from other centres of fœtal growth. The primary origin of these tumors necessarily must correspond to the location of one of these branchial clefts, and clinical experience has demonstrated that they are most frequently found in the region of the second and third branchial clefts, in the vicinity of the larynx, pharynx, and in intimate relation with the sheath of the large vessels of the neck, in contradistinction to dermoid cysts about the orbits and in the scalp, which are more superficially located (Langenbeck). In the case of a young lady, Langenbeck observed a cyst situated on the left side of the epiglottis and pharynx, which occupied one-half of the floor of the mouth, and which projected from underneath the chin on that side in the shape of a smooth tumor of the size of a fist. Respiration, deglutition, and motion of the tongue were greatly impeded. The

cyst contained eight ounces of atheromatous matter. The same author states that he has frequently found these tumors attached to the greater horn of the hyoid bone or to the thyro-hyoid ligaments, localities which plainly indicate that they originated from remnants of former branchial clefts.

We shall have frequent occasion to allude to the intimate connection of these tumors with the sheath of the large vessels of the neck, consequently it is very important to study their anatomical relations to these important structures. The jugular vein is surrounded throughout its whole course in the neck by a distinct and separate sheath of areolar tissue, which, on the outer side of the artery, penetrates into the deep tissues of the neck, thus completely separating the two vessels. The jugular, enclosed in its sheath, may be easily drawn over the artery toward the median line without producing any change of location of the artery. The vein being in front of the artery, and covering half of the lumen of the latter, it can be readily understood that when the vein is drawn forward with its sheath, it can be injured while the artery is not exposed to the same danger. Branchial cysts of the second and third clefts are always observed in the sheath of the large cervical vessels, usually in the carotid triangle above the omo-hyoid muscle. They appear to occur more frequently on the left side of the neck. Their shape is invariably round or oval, with a smooth surface. The contents of these cysts being either fluid or semi-fluid, fluctuation can be felt, more particularly if the tumor is palpated between two fingers from the pharynx or the floor of the mouth and the external surface. Only lateral motion of the tumor is possible, on account of its peculiar attachments to the deep tissues of the neck. If the tumor is only of moderate size, the pulsations of the carotid artery can be felt on its inner margin. If it is large, it overlaps the artery,

when the pulsations of the vessel are communicated to the tumor. Smaller tumors can be made to pulsate, by bending the head backward and in a direction opposite to the tumor.

HISTORICAL NOTES.

Nearly forty years ago Roser of Marburg made the statement that many of the so-called ranulas about the base of the tongue, the mucoid and dermoid cysts of the upper cervical region, are due to imperfect closure of one of the branchial tracts. All of these tumors he included in one group under the name of branchial cysts. He described three distinct conditions which may result from entire absence or imperfect obliteration of any one of the branchial clefts.

1. Branchial fistula in case the entire tract remains patent.

2. Cystic fistula in case only one extremity of the cleft is obliterated while the other communicates with the pharynx or the cutaneous surface.

3. Branchial cysts in the event the tract is closed at both ends while between them it remains open, and by proliferation from the inner surface produces an accumulation—the contents of the cyst.

Although these tumors are by no means common, a sufficient number of well authenticated cases have been placed on record which remove all doubt as to the etiological relations which exist between imperfectly obliterated branchial clefts, the serous, dermoid, and the so-called deep-seated atheromatous tumors, of congenital origin and located in the regions formed by the branchial clefts. These tumors have since been made a special object of study by B. von Langenbeck, Luecke, Gurlt, Virchow, Schede, Esmarch and Heusinger.

CLASSIFICATION OF BRANCHIAL CYSTS.

Branchial cysts should be classified according to their contents. The cyst walls being lined with epi-

thelium, the only histological element in the contents are epithelia. In most instances the epithelia lining the cysts belong to the tesselated variety, but Rehn discovered in a blind congenital fistula ending near the mucous membrane of the pharynx, ciliateed pithelium; and Neumann found cylindrical and pavement epithelium in two cystic tumors of the neck, one of which was congenital, while the other was developed in later years. The presence of ciliated epithelium may be explained by assuming its origin to have been in the upper part of the cleft, the fornix pharyngis, where these fistulæ oftentimes end, and where ciliated epithelium normally exists. The lower end was probably lined with flat epithelium.[1] The physical and chemical properties of the cyst contents will depend largely on the amount and degree of retrograde transformation of the epithelial proliferation. In making the character of the cyst contents a basis for classification it is, however, important to remember that like in ordinary retention cysts, the contents of a branchial cyst are liable to undergo changes depending on the retrograde changes of the epithelial product, hæmorrhage and other transudations into the sac, or the occurrence of inflammation in the cyst wall itself. It is only during the earliest stage that the specific secretion is found in its purity. In the course of time the original character of the contents of the cyst may be completely lost by retrograde metamorphosis, or the addition of new material. Clinical experience and pathological examinations have shown that these tumors, according to the physical properties of their contents, may be divided into the following four principal varieties:

1. Mucous cysts; 2. Atheromatous cysts; 3. Serous cysts; 4. Hæmato-cysts.

Variable as the contents of these different varieties

[1] Kœnig, Lehrbuch der spec. Chirurgie. Berlin, 1878. Vol. i, p. 454.

may be, more uniformity is observed in the structure of the cyst wall. In the primary stage of the affection it consists of a connective tissue capsule with an epithelial lining on its inner surface, and a delicate layer of a loosely connected reticulum of connective tissue (pericystium) which is very vascular and covers the outer surface of the cyst. A high degree of intracystic pressure may cause atrophy of the epithelial lining and thinning of the walls of the sac and, on the other hand, inflammatory proliferation produces great thickening of the cyst walls. While dermoid cysts contain the characteristic secretions of the skin and its appendages, the branchial cysts only contain the products of the epithelial cells because their walls do not contain any hair follicles, sebaceous or sweat glands, as the branchial clefts close before these appendages are formed.

1. *Mucous branchial cysts.* As a primary formation this form of branchial cyst is usually found in the upper branchial clefts. Their origin is attributable to an imperfect closure of the upper portion of the branchial tract, consequently the cyst wall may derive its lining from the mucous membrane of the pharynx, and the retention of the physiological secretion produces a mucous cyst. Many of the so-called ranular cysts about the base of the tongue belong to this variety of tumors. Among the six types of branchial cysts mentioned by Roser, the third variety consists of a cystic formation which extends from under the tongue towards the neck; the sac assumes an hour-glass shape, the constricted portion connecting the cervical with the lingual portion of the cyst. By making alternate pressure over the cyst, the contents may be squeezed from one portion of the cyst into the other. Congenital mucous cysts in the region of the base of the tongue and sides of the larynx in the majority of cases are due to an imperfect closure of the upper portion of one of the branchial tracts.

2. *Atheromatous branchial cysts.* This form of branchial cysts has been described by some authors as deep-seated atheromatous cysts of the neck (Schede), and dermoid cysts of the sheath of the large vessels of the neck (Langenbeck). They are usually located in the second and third branchial tracts in the region of the hyoid bone, and intimately connected with the sheath of the large cervical vessels. These cysts contain an atheromatous material resembling the contents of an ordinary retention cyst of the skin, with this difference, however, that they never contain anything which would indicate the presence of hair follicles, as lanuginose hair or sebaceous material, or any of the more complicated products of dermoid cysts. Schede[1] has made a careful microscopical examination of the sac of a deep-seated atheromatous branchial cyst. The specimen was hardened in Müller's fluid. The inner surface of the sac was lined with layers of tesselated epithelium. The deeper layers were composed of oval or spindle-shaped cells with delicate filiform processes which were arranged in a perpendicular direction to the walls of the cyst. The nuclei were either longitudinal and granular or round, completely filling the centres of the cells. If any attempts were made to tear the epithelia from their points of attachment it was observed that the different layers were arranged in such manner as to appear dovetailed. The superficial layers showed large polygonal cells with distinct nuclei. The portion of the capsule next to the epithelia, consisted of thick concentric layers of thin fibrillated areolar tissue. Occasionally the fibrils were wanting, their space being occupied by a pale homogeneous mass of a granular substance. Outside of this structure the capsule was composed of strong bundles of connective tissue

[1] Ueber die tiefen Atherome des Halses. *Archiv f. Klin. Chir.*, vol. xiv, p. 1.

which were arranged in concentric layers, but forming a distinct reticulum. The blood-vessels in the walls of the sac were scanty, small in size, with exceedingly thin walls penetrating as far as the epithelial lining. No trace could be found of hair follicles, sudoriparous, or sebaceous glands.

For the purpose of furnishing a clear clinical picture of this form of branchial cysts I will give a synopsis of a few typical cases.

Langenbeck's case.[2] The patient was a female 17 years of age. Suffered from enlargement of cervical glands during her 12th year. Two years before the operation a soft swelling was noticed in the region of the left carotid triangle, which soon increased to the size of a hen's egg. A year later the whole neck, but especially the left side, was swollen, and the tonsils at the same time were considerably enlarged. Pains in the neck, and frequent attacks of angina had preceded these symptoms. The usual medicinal treatment in such cases and a visit to Kreuznach improved her general health, but the tumor increased in size, became more prominent, and showed distinct signs of fluctuation. At the time of operation, two years after its appearance, the tumor was oval in shape, and extended from the angle of the jaw downwards to a line on a level with the cricoid cartilage. Externally it was not very prominent, but on further examination it was evident that its base was firmly attached to the sheath of the large cervical vessels. The tumor could be felt through the walls of the pharynx, where fluctuation was distinctly felt. The anterior margin of the sterno-cleido-mastoid was somewhat elevated by the outer portion of the tumor, which received a distinct impulse from the underlying artery. The pulsations were felt most distinctly when the head and neck were turned toward the op-

[2] Beiträge zur chir. Pathologie d. Venen. *Archiv f. Klin. Chir.*, vol. i. page 1.

posite side and in a backward direction. The tumor was punctured and a mass of yellowish semi-solid substance escaped, the solid portions of which were composed of epithelial cells and cholesterine crystals. The puncture was kept open by a linen tent. Later injections were made into the interior of the cyst of tr. iodinii, and when this produced no effect a concentrated solution of nitrate of silver was tried with no better result. The wound was kept open for a long time, but in spite of all efforts the cavity showed no tendency to close. A year later a seton was passed through the tumor, but without success, for as soon as it was removed the openings closed, and the cyst increased to its former size, causing pain and pressure, necessitating an incision which gave exit to a large quantity of fœtid pus. For four months the wound was kept open and iodine injections were again resorted to, but with no better effect than before. Nearly three years from the time the cyst was first noticed it was removed by extirpation. An incision was made along the anterior border of the sterno-cleido-mastoid, extending from the angle of the jaw towards the cricoid cartilage. In consequence of the long-continued inflammation, the cicatricial adhesions between the cyst walls and the surrounding tissues were found very firm, and could only be separated by a tedious and difficult dissection. When an attempt was made to isolate the tumor from the deep structures it was found to be intimately connected with the sheath of the internal jugular vein, so that, on making traction, the vein was elevated from its bed while the artery remained *in situ*. The base of the tumor and the vein appeared to form one coherent mass. The tumor was carefully drawn forward, the sheath of the vein opened and the attachments separated with the handle of the scalpel. The cyst extended upwards close to the jugular foramen and was attached to the styloid process. When the tumor

was removed, the parotid gland, the styloid process, the submaxillary gland, and the right wall of the pharynx became visible in the wound. The internal jugular vein, deprived of its sheath, was seen completely isolated throughout the whole length of the wound. The carotid artery enclosed in its sheath lay also exposed in the wound. Hæmorrhage was moderate. Adhesive strips and lint compress constituted the dressing. The patient recovered without any untoward symptoms.

Langenbeck's case.[1] This was again a female, 20 years of age, otherwise in robust health, who consulted von Langenbeck in May, 1855. When nine years of age a tumor appeared on the left side of the neck, which rapidly increased in size. One year later Dieffenbach made an attempt to extirpate it, but when he discovered that it was adherent to the deep tissues of the neck he desisted from any further attempts to remove it, and contented himself with making an incision into the sac and emptying its contents, which had the appearance of a thin gruel. The cyst refilled and was again reopened by means of the actual cautery, the contents being of the same character as before. The wound was kept open for a number of years, and the cyst discharged continually. Finally the opening closed, and the tumor disappeared almost completely until, in 1854, it again increased in size, and when first seen by Langenbeck, it was as large as a pigeon's egg. It occupied the left side of the neck on a line with the upper border of the thyroid cartilage, and between it and the inner border of the sterno-cleido-mastoid. It was firm, but imparted to the touch an indistinct sense of fluctuation. The cicatrices resulting from previous operative procedures had produced firm adhesions between the sac and the skin. With some difficulty the tumor could

[1] Op. cit., p. 25.

be separated from the artery. Its location rendered it probable that it was connected with the sheath of the cervical vessels. As the tumor increased and became more painful, it was extirpated May 10, 1855. The unyielding cicatricial tissue was included in the incision and removed, the fascia of the neck was divided and the inner border of the sterno-cleido-mastoid exposed. It was found extremely difficult to sever the adhesions around the cyst walls, and the sac was ruptured on the inner surface during one of these attempts. The collapsed sac was seized with sharp hooks and drawn over toward the median line of the neck, and while the sterno-mastoid muscle was pushed in an opposite direction the dissection was continued carefully toward the base of the tumor. A broad pedicle connected the cyst with the large cervical vessels. With the index finger the carotid artery was pushed backwards and outwards with a view to keep the jugular vein, which was on the outer side of the artery, at a safe distance. As the pedicle was being divided with the scissors a sudden gush of dark venous blood welled up from the bottom of the wound, which in a moment completely flooded the neck and the operating table. The operator immediately made digital compression above and below the wound, while an assistant made direct compression with a sponge. The hæmorrhage soon ceased and the sponge was carefully removed. A careful inspection of the floor of the wound showed that the jugular vein was completely out of sight, covered by the muscular tissues of the neck, and as the hæmorrhage had ceased, it was not deemed advisable to resort to any severer measures for the purpose of guarding against another attack of hæmorrhage. After removing all coagula the wound was filled with lint, its margins were drawn together with strips of adhesive plaster, over which a compress was applied. An icebag was placed over the seat of operation. The wound healed kindly and

the patient made a complete recovery. An examination of the cyst revealed that a piece of the anterior wall of the internal jugular vein, four lines in length, and two and one half lines in width, was attached to its under surface. Professor A. Luecke, then Langenbeck's assistant, in a paper on "Atheromatous Cysts of the Lymphatic Glands,"[1] makes the following comments on Langenbeck's first case: The attempt to remove the tumor by puncture and subsequent injections of iodine had failed, hence extirpation was resorted to. Traces of the former operative procedures may still be seen in the tumor, and its peculiar structure renders evident why simple puncture and injection proved unavailing. The external appearance of the tumor presents a greater similarity to an hypertrophied lymphatic gland than to an atheromatous or dermoid cyst. It has the same oval shape, and the different processes of areolar tissue that I have observed in cases of lymphatic sarcomata. It is surrounded by a thin capsule of areolar tissue and before removal gave evidence of distinct fluctuation. To differentiate between a tumor of this kind and a suppurating hypertrophied lymphatic gland is, even after removal, extremely difficult if not impossible. Errors in diagnosis are therefore not only possible but often unavoidable, but fortunately they are of no great consequence in respect to the treatment. When an incision in the tumor was made a purulent fluid was discharged, which under the microscope presented the characteristic atheromatous matter.

Gurlt[2] mentions the great similarity existing between the contents of these tumors and those of ovarian cysts. We see in our case under the microscope, fat-cells, large masses of epithelia either without or with multiple nuclei. Many cells are filled

[1]Ueber Atheromcysten der Lymphdrüsen. *Archiv f. Klin. Chir.* vol. 1, p. 356.

[2]Die Cystengeschwülste des Halses. Berlin, 1855, p. 268.

with free molecular fat, others contain fat-cells, and occasionally large nuclei are seen. We also observe the well-known crystals of cholesterin and small prismatic crystals which seem to be some form of inorganic salt, also lime in granular form. He quotes F. Hoppe, who has made a careful chemical examination of the contents of an atheromatous cyst, and has found the following to represent its chemical composition: 1.3953 grammes of atheromatous material contained the following: 0.2225 alcoholic extractive matter, 0.1235 ethereal extractive matter, 0.2005 aqueous extractive matter, 0.8555 insoluble matter. In these different ingredients he found leucin, tyrosin, cholesterin, myelin, palmitin, and stearin. Usually these cysts constitute spherical cavities surrounded by a thin smooth membrane, rarely with thickened walls or wart-like elevations, or fan-shaped protuberances, but in this instance we see cavities of greater or less size embedded in a dense parenchyma of a reddish white color which constitutes the bulk of the tumor. The cavities are distinctly separated from each other, and are not in contact with the external capsule of areolar tissue. Wart-like vegetations cover the cyst wall and protrude from it. Sections through the parenchyma show small spaces separated by areolar tissue and filled with granular matter. The contents of these follicles are lymph corpuscles and amyloid granules. These latter were soluble in glycerine, but remained unaffected by acids and alkalies.

In opposition to the views advanced by Luecke, it may be stated that the consecutive attacks of inflammation and suppuration so modified the contents and altered the structure of the cyst walls that the primary structures of the tumor was lost. The cyst wall by chronic inflammation became thickened, and the tissue proliferation of the adjacent structures may have invaded the interior of the sac and thus rendered an anatomical diagnosis

exceedingly difficult or impossible. The location of the tumors, the clinical history, as well as the age of the patients, render it more than probable that both of Langenbeck's cases were atheromatous branchial cysts.

Schede calls these cysts deep-seated atheromatous cysts of the neck, without reference to their origin from imperfectly closed branchial clefts. I will describe in brief the three cases that came under his observation at Volkmann's clinic.

Volkmann's case reported by Schede.[1] The first case was that of a young man 17 years of age, who had always enjoyed perfect health. Two years before the operation the patient noticed a small smooth and round tumor which began to develop on the side and upper portion of the neck close to the anterior margin of the sterno-cleido-mastoid. It was painless, somewhat movable, and soon increased in size so as to give rise to deformity, and difficulty in deglutition. In February, 1870, it had reached the size of a goose-egg, presenting a smooth surface and a round or oval contour. The tumor was punctured at this time with a trocar, when about 30 grms. of a cream-like fluid was removed. The puncture was followed by an injection of tr. iodinii which was again withdrawn after remaining for a few minutes. The microscope showed an abundance of large flat cells in the fluid removed. In a month later the tumor had returned to its former size. A longitudinal incision was now made over the tumor and the cyst extirpated. The adhesions were not firm, and the operation was completed without meeting with any difficulties. The tumor was situated upon the sheath of the large cervical vessels, but was easily separated from them. Posteriorly it extended to a point between the pharynx and trachea. The wound healed promptly and the patient recovered completely.

[1] Ueber die tiefen Atherome des Halses. *Archiv f. Klin. Chir.*, vol. xiv, p. 1.

Volkmann's second case reported by Schede.[1] This was also a young man 15 years of age, who, 18 months previously, noticed a small tumor on the anterior margin and about the middle of the sterno-cleido-mastoid. It increased slowly in size and resisted all ordinary attempts at treatment. When he came under Volkmann's care it had attained the size of a hen's egg. It was painless, oval in shape, with a smooth surface, and presented evidences of fluctuation. The extirpation of the tumor was again done and presented no difficulties whatever, as the attachments were not firm and could be easily separated. Posteriorly it reached as far as the cervical vertebræ, which could be plainly felt after the removal of the cyst. The walls of the sac were very thin and a microscopic examination of the contents revealed the presence of epithelial cells in a state of fatty degeneration.

Volkmann's third case reported by Schede.[2] This case was a female, 22 years of age, who, when 11 years old, noticed a small tumor in the left upper cervical region. Irritating applications had induced inflammation, suppuration, and a spontaneous evacuation of a thin sanious pus, whereupon the tumor disappeared. In her 17th year the tumor reappeared in the same place which, in spite of all treatment, increased in size, encroaching somewhat upon the cavity of the mouth. At the time the operation was performed it extended from the mastoid process to the angle of the jaw, being about 2½ inches in length and 1½ inches in breadth. The tumor was painless and movable, moderately tense, and through the mouth fluctuation could be detected. The cyst was removed through an incision parallel with the lower margin of the jaw. The adhesions in front and on the sides of the tumor were slight, but the attachments to the

[1] Op. cit. p. 3.
[2] Op. cit. p. 3.

styloid process were firm, and were severed with the finger. The sac was opened and contents evacuated to facilitate the detachment of the cyst from the deep structures beneath; this was done with curved scissors. The tumor was not adherent to the sheath of the large cervical vessels in this case. Like in the preceding cases, the contents were composed largely of epithelial cells. Recovery was prompt and permanent.

The cases reported by Schede furnish an instructive and practical illustration of the fact that the firm adhesions to the sheath of the deep cervical vessels which were observed in Langenbeck's cases are the direct result of prolonged irritation and inflammation in the walls of the sac and the adjacent tissues, and that the removal of these tumors can be accomplished with comparative ease provided such inflammation has not preceded the operation.

Virchow's case.[1] Under the name of auricular teratoma of the neck, Virchow describes a branchial cyst in the person of a seamstress 24 years of age. It was first noticed when the patient was in her 14th year, when it was as large as a filbert. It increased slowly in size, and when first seen by Virchow it had attained the size of a goose-egg. It was located between the angle of the jaw and the mastoid process, and was firmly attached to the sheath of the carotid artery. The cyst was filled with a creamy yellowish fluid which contained free fat and epithelia. The walls were studded with sebaceous follicles, especially on the side toward the carotid artery. The portion attached to the sheath of the vessels contained a plate of cartilage which resembled the cartilage of the ear, hence he designated the tumor as an *auricular* teratoma. Virchow attributed the origin of this and analogous growths, to an imperfect obliteration of

[1] Virchow u. Hirsch's Jahresbericht, 1866, vol. ii, p. 418.

one of the branchial clefts. In his classification he includes the cysts which are developed from branchial clefts among the teratoid tumors.

Three cases of atheromatous branchial cysts have come under my own observation.

Case I. Mrs. H., æt. 36, German. Family history reveals no tendency to congenital malformations. General health excellent. About a year ago the patient discovered a small tumor on the right side of the neck between the angle of the jaw and the larynx, which slowly increased in size, and after a few months became the seat of an acute inflammation which terminated in suppuration, requiring an incision for the relief of urgent symptoms. The fluid which escaped consisted of pus mixed with a gruelly substance. Prompt relief followed the incision. The inflammatory symptoms subsided and the tumor diminished in size. In a few weeks the opening closed, leaving a small and painless swelling. The same symptoms were repeated about four months subsequently. When the patient came under my observation during the summer of 1883, I found a tumor about the size of a hen's egg located between the angle of the jaw and the larynx, resting directly upon large vessels of the neck, as was evident from the distinct pulsations which it received and which could be seen and felt. The posterior portion was under the sterno-cleido-mastoid. Over its centre was seen the scar which had resulted from the previous incisions. The swelling presented a regular smooth surface and an oval outline with the long diameter parallel to the cervical vessels. (Fig. 1.)

It was only slightly movable from side to side and perfectly immovable from above downward, showing that it had a firm point of attachment to the deep tissues of the neck. Fluctuation could be detected on the outer surface and also through the mouth. The original location corresponded to the third branchial cleft. As it had on two different

Fig. 1.

occasions undergone acute inflammatory changes without any benefit resulting from them, the extirpation of the cyst was deemed the only measure which promised a permanent result. The operation was done under antiseptic precautions. A straight incision was made over the tumor parallel to the sterno-cleido-mastoid. The cyst was found firmly adherent to the surrounding tissue as the result of the antecedent inflammatory infiltrations and required much time and patience in its separation. After isolating it from all attachments on its sides, it was seized with a tenaculum forceps and drawn forward and toward the median line of the neck, while the sterno-cleido-mastoid was held in an opposite direction so as to afford easy access to its base. The attachments here were very firm, and it appeared as though the base of the tumor and the large cervical vessels underneath were imbedded in a mass of cicatricial tissue. Keeping as close to the cyst wall as possible,

the dissection was continued very carefully, proceeding mostly with blunt instruments. When nearly one-half of the pedicle was separated in this manner, we were suddenly surprised by a tremendous gush of dark venous blood, which in a second flooded the whole field of operation. It was only too evident that the internal jugular vein had been torn, and, for the purpose of preventing further loss of blood and to guard against instant death by admission of air into the vein, I made firm digital compression above and below the injured vein, while an assistant pushed a sponge into the wound. Hæmorrhage was controlled in this manner, and as soon as I could be relieved by one of my assistants I removed carefully the sponge, and, after locating as nearly as possible the exact seat of bleeding, I seized the vein with some of its adjacent tissues with a stout pair of hæmostatic forceps. I was fortunate enough to grasp the bleeding point at the first attempt, and the hæmorrhage was completely controlled. The tumor was now removed, and by making slight traction on the forceps the vein was drawn forward and a catgut ligature applied without isolating the vessel. I was unable to ascertain the exact size or direction of the wound in the vein, but the ligature arrested the hæmorrhage promptly and permanently. The wound was thoroughly irrigated, and, like in Langenbeck's case, the vein seemed to disappear underneath the deep tissues of the neck. In the wound could be seen the œsophagus, lateral wall of the larynx, carotid artery in its sheath, and the great horn of the hyoid bone. After suturing and draining the wound a graduated compress was applied. For the first 24 hours after the operation the patient suffered from intense headache in the corresponding side, which induced me to believe that the circulation in the vein had been completely interrupted, either by the ligature alone or by the formation of a thrombus at the point of ligation. After the

first 24 hours the patient suffered no further inconvenience. The wound healed by primary union and the recovery has been permanent and complete. There is no question but that the adhesions of the cyst with the sheath of the cervical vessels were due to the attacks of acute inflammation which had preceded the operation on two different occasions. A microscopical examination of the contents showed flat epithelial cells, cholesterine crystals, fat granules, and a mass of debris, the product of epithelial degeneration. The cyst wall was composed of connective tissue, thickened and infiltrated with embryonal elements and lined with flat epithelial cells.

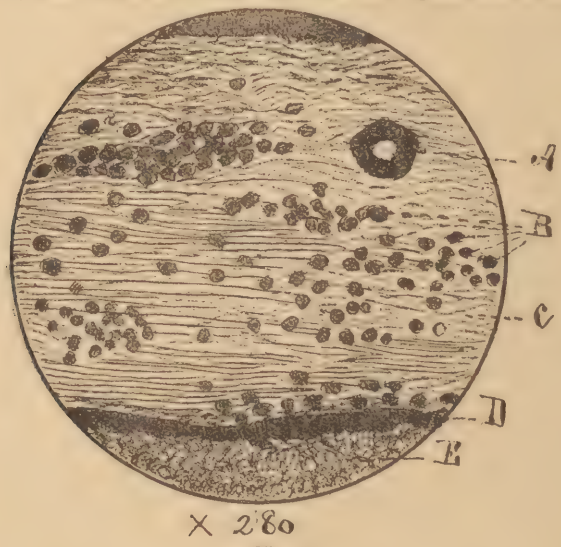

Fig. 2.

STRUCTURE OF CYST WALL.

A) Arteriole. *B*) Infiltrated in flammatory products. *C*) Fibrous tissue. *D*) Lining membrane. *E*) Contents of Cyst.

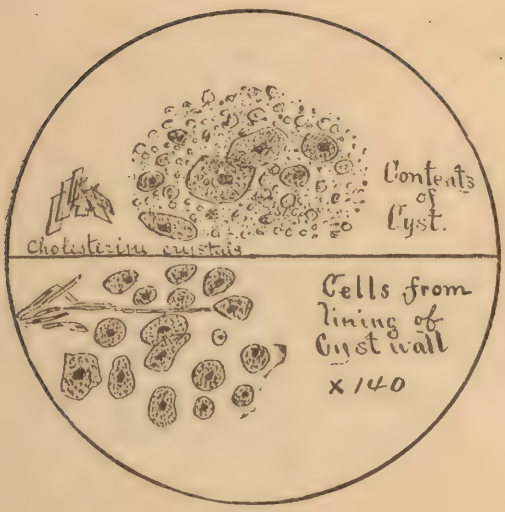

Fig. 3.

Case II. Mrs. P., æt. 22, American. Family history good, especially in reference to congenital deformities. About a year ago she noticed on the right side of the neck near the angle of the jaw a small deep-seated tumor, which, after attaining the size of a filbert, remained stationary, at times even diminishing somewhat in size. About two months ago it began to increase in size, and became the seat of a feeling of distress and pain. When she presented herself for examination (Dec. 13, 1883), it was about the size of a hen's egg. It is located over the bifurcation of the common carotid artery, pulsates distinctly, and makes pressure against the floor of the mouth and larynx, and reaches from the lower jaw to the upper border of the thyroid gland. Fluctuation is distinct, and can be distinguished through the mouth. The skin over it is natural in appearance and movable. At the base of the tumor

firm attachments fix it to the deep tissues of the neck, which prohibit any motion from above downward, while slight lateral motion is possible. The history of the case, the age of the patient, the location of the tumor in the region of the third branchial cleft, appeared to furnish sufficient evidence to justify me in diagnosing an atheromatous branchial cyst. The patient objected to an operation, and I have not been able to ascertain the subsequent history of the case.

Case III. *Branchial cyst in the region of the second branchial cleft.* Mary H. æt. 25, German. Her family history is good, especially regarding congenital malformations, as tumors or fistulæ in the cervical region. Patient has always appeared round and full underneath the chin, but during the last four years a tumor has been growing rapidly on the floor of the mouth until, at present, it is considerably larger than a goose egg. The mouth is completely filled by it, the tongue is pressed against the palate, its movements are limited, only the tip of it being visible at the upper border of the tumor, and speech and deglutition are greatly impeded. (Fig. 4.)

Laterally, the tumor extends to near the angles of the inferior maxillary bone, and downward it overlaps the larynx and upper part of trachea, entirely obliterating the round contour of the upper cervical region. It is painless, and distinctly fluctuating to the touch, presents a smooth surface, and gives rise to no further inconvenience except from its mechanical interference with speech and deglutition. When the patient opens her mouth the apertures of Wharton's ducts are plainly visible on each side of the median line, and by exerting lateral pressure upon the sub-maxillary glands the patient can expel a stream of saliva from them. Previous treatment, as external application of iodine, etc., had had no effect on the growth.

Fig. 4.

Small dots in the mouth to represent the openings of Wharton's ducts.

Operation. Desiring to avoid any deformity resulting from an external cicatrix, it was decided to remove the tumor through the mouth. A linear incision was therefore made in the median line, from above downward, extending from the tip of the tongue to the symphysis of the lower jaw, carefully avoiding the ducts of the salivary glands. When the sac of the tumor was reached, the adhesions existing between it and the surrounding tissues were easily severed with the handle of the scalpel. After freeing about one-half of the tumor in this manner it was found that it would be impossible to remove the tumor in its entirety in this manner, owing to its immense size. The sac was therefore opened and a large quantity of its gruelly contents removed by pressure. The operation then proceeded without any

difficulty until the entire cyst was removed. It was now noticed that the cyst was constricted in its middle by the inferior maxillary bone, the upper and lower portions of it bulging out on both sides of the constriction. There was no hæmorrhage worth mentioning. The body and great wings of the hyoid bone could be plainly felt in the posterior recess of the wound. The cyst wall was thin, its external surface quite vascular. The microscopical examination of the contents of the cyst, as well as the primary location of the tumor, revealed its branchial origin. The wound was united with sutures, and a drainage-tube inserted. A compress underneath the chin fastened by a roller bandage, completed the dressing. The next day considerable swelling existed in the mouth, and had caused the sutures to cut through the tissues. The sutures were therefore taken out, and in place of the drainage-tube a pledget of iodoform gauze inserted, with the effect of entirely destroying the unpleasant odor which had arisen during the first 24 hours. In a few days the œdema subsided and the wound in the floor of the mouth had healed by granulation. The difficulty of swallowing and speaking disappeared, and nothing in the looks of the young lady shows any traces of the deformity which was disfiguring her face and neck previous of the operation.

Serous branchial cysts. This variety of branchial cysts is composed of thin cyst-walls and serous contents, and may develop from any one of the branchial clefts which fail to obliterate completely. This affection has been described under the name of *hydrocele colli* (Mannoir), congenital hygroma of the neck (Wernher), congenital hydrocele of the neck, and congenital cystic tumor of the neck (Thomas Smith). Mannoir, under the name of *hydrocele colli*, described certain serous cysts occurring between the angle of the jaw and the mastoid process, and between the

larynx and the anterior margin of the sterno-cleido mastoid, a region which corresponds to the second and third branchial clefts, which were supposed not to be congenital. We have seen, however, that branchial cysts are not necessarily developed during intra-uterine life or soon after birth. All that is necessary is that the matrix for the cysts be present at birth, from which, at some future time, the tumor is developed. These tumors appear as single or multilocular cysts with thin membranous walls; their internal surface is lined with pavement epithelium. Like a serous membrane, they contain a limpid, watery, or tenacious fluid, holding in suspension epithelial cells and cholesterine crystals. These cysts are formed anywhere in the neck, within the area of branchial clefts, between the lower jaw and clavicle. They are usually deep-seated and occasionally superficial. They are painless and give annoyance only from their size. Clinically, they may be recognized from their location, their globular cystic form, soft fluctuating feel and painless growth. The existence of tesselated epithelium upon the inner surface of these cysts has been demonstrated by Neumann and Baumgarten. When these cysts spring from the second or third branchial clefts they are usually deeply located. Hueter,[1] in extirpating a tumor of this kind in a child two years of age, ascertained that it extended between the two carotid arteries back to the walls of the pharynx. When they are deeply situated they are usually in contact, and connected, with the sheath of the large cervical vessels, receiving a distinct impulse from the underlying artery. When thus located they offer the same difficulties to extirpation as the atheromatous variety. The following cases may serve as illustrations of this type of branchial cysts:

[1] Grundriss der Chirurgie, 1880, vol. ii, p. 326.

Wernher's case.[1] The patient was a healthy female child, which was born with a tumor on the left side of the neck, filling the whole space between the lower jaw and the clavicle, and from the ear to the median line of the neck. The tumor was smooth, tense, elastic, and fluctuating; toward the front part was a small abrasion. Respiration and deglutition were unimpaired. The tumor increased rapidly during the first ten days of the child's life. Wernher, to satisfy the mother, ordered a liniment containing two grains of pot. iod. to an ounce of oil. After a few days a small opening formed through which a dark, brownish-red syrupy fluid escaped for some days. No suppuration. The tumor sensibly diminished. After a time other openings formed in other cysts composing the growth, and the whole tumor began to shrink from the jaw toward the clavicle. Six months subsequently the child died of small-pox, and a post-mortem examination demonstrated that the tumor had completely disappeared.

Thos. Smith's case.[2] Geo. A., æt. 8 months. Healthy child, and well nourished. At the time of his birth a swelling was noticed behind his right ear, about the size of a hen's egg. This had gradually increased in size up to the time when he was first seen. It was then as large as a fist, and was situated in the posterior triangle, running up behind the ear and toward the angle of the jaw. The tumor was cystic, and evidently contained fluid. In parts it was tense and elastic, and elsewhere it felt flaccid, semi-solid, and lumpy. Smith passed a seton formed of a single thread of fine silk through the most prominent part of the tumor. The immediate result was to diminish the size of the swelling considerably, and subsequently to cause inflammation, suppuration, and

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[1] Die angeborenen Kysten-Hygrome, Giessen, 1843.

[2] Congenital Cystic Tumor, by Thos. Smith. St. Bartholomew's Hosp. Rep., vol. ii, p. 16.

discharge from two of the cysts. Three weeks after the introduction of the seton the cysts had quite collapsed, and the tumor had lost about two-thirds of its size. Another seton was introduced, with the result of still further diminishing the size of the tumor until it was no larger than a marble.

The same author reports another case, which would show that these cysts may occasionally disappear by spontaneous absorption of their contents. The patient was a healthy babe, 3 weeks old. Immediately after birth a swelling was noticed in the neck, which rapidly increased in size. When first seen, a cystic tumor occupied almost the entire region of the left side of the neck, extending from under the lower jaw to the clavicle. The mother objected to any kind of treatment. Three months later the child was seen again, when the growth had greatly diminished in size. There was nothing to be felt but a loose, flabby cystic mass not much larger than a hen's egg. The skin over it was shrivelled, loose and baggy. Three months later the tumor was still smaller.

That these tumors may sometimes attain an enormous size, is evident from the following case reported by Frederic Treves.[1] It occurred in an infant, and took its origin in the region of the inferior maxillary bone, and occupied the whole side of the neck and upper part of the thorax on the same side, from where it extended as far as the umbilicus. It contained one large and numerous smaller cysts, corresponded to the region of the second branchial tract. No histological report of the specimen.

A very interesting description of a double branchial cyst is given by Vonwiller.[2] The specimen is contained in the Dresden Anatomical collection. The

[1] Dissection of a Congenital Hydrocele of the Neck. Trans. Path. Soc., xxxii, p. 194. Virchow u. Hirsch's Jahresbericht, 1882, vol. i, p, 280.

[2] Ueber einige angeborene Tumoren. Inaugural Diss. Bern, Zürich 1881. Centralblatt für Gynæcologie, 1882, p. 235.

fœtus, of about 6 months, besides slight abnormities of the extremities and cleft palate, presents in the region of the neck a tumor nearly double the size of an infant's head, which is divided in the median line by a depression, which separates it into two symmetrical halves. The tumor reaches from the lower margin of the ear and the linea semicircularis of the occipital bone nearly to the apex of the scapula. Larynx and trachea free. Palpation reveals that the tumor consists of two large separate cysts. The skin over the cysts is thin and firmly adherent. The inner surface of the cysts is smooth, and resembles a serous membrane. No projections or remnants of septa can be seen. The septum dividing the two cysts is attached to the middle of the occipital bone and the spinous processes of the cervical vertebræ. It is covered with a similar membrane as the cysts, and separates them completely. The cysts do not communicate with the cavity of the cranium or spinal canal, nor with the mouth or pharynx. The inner surface of the cysts is lined with epithelium, only a small amount of solid contents composed of conglomerations of fatty epithelial cells. The anatomical diagnosis reads: Double branchial cyst—*Hydrocele colli congenita duplex*. The cysts originated, probably, in the cleft between the second and third branchial arches.

I will add another case, which came under my own observation.

Case IV. *Serous branchial cyst in the fourth branchial cleft.* The patient was a healthy, strong male child, 6 months of age. There is no history of congenital malformation, especially branchial fistula, in the family. When the child was born a small tumor the size of a pea was discovered on a level and somewhat to the inner side of the sternal origin of the sterno-cleido mastoid muscle. The tumor was painless and movable, but rapidly increased in size.

When the child was brought to me, it was as large as a walnut. The skin over the tumor was natural in appearance and movable. The tumor itself presented a smooth surface. Fluctuation was distinct, but the cyst appeared to be somewhat firmly attached to the subjacent tissues. The cyst was readily enucleated, the adhesions not being very firm except over the most prominent point of the tumor, where inversion of the skin had undoubtedly occurred during the closure of the external opening of the fourth branchial tract. The adherent portion of the skin was excised with the tumor. The cyst is oval in shape, smooth, the outer layers quite vascular. The walls are thin, the contents serous, which render the whole tumor translucent. The wound was closed with sutures, and heale by primary union under an antiseptic dressing.

4. *Hæmato-cysts of branchial clefts.* In some instances of serous branchial cysts the fluid is discolored by an admixture of blood from minute hæmorrhages into the sac, but when the contents are of such dark color as to resemble venous blood they are properly called hæmato-cysts, and from a pathological, diagnostic, and clinical point of view constitute a distinct and well-marked variety of branchial cysts.

Albert[1] remarks that two kinds of these cysts have been observed: 1st. Such as may be emptied by pressure and are in communication with blood-vessels. 2nd. Those which cannot thus be emptied, and which simulate the appearance of an ordinary serous cyst so closely that their nature is only recognized by puncture. The latter class, when they occur in the neck, usually belong to the branchial cysts, because they are observed during early life and originate in places which correspond to the location of the branchial clefts. This variety of cysts has been called *hæmatocele colli*, by Michaux, and hæma-

[1] Lehrbuch der Chir. u. Operationslehre, vol. i, p. 443.

toma by J. P. Frank. Aside from their origin from branchial clefts, and the admixture of blood with the contents of serous cysts, such cysts may develop from dilated veins, both extremities of the dilated portion undergoing contraction and finally complete obliteration, completely isolating the contents of the cyst from the general circulation. Again, a vein may dilate at one point, forming a pouch or sac, and by contraction and obliteration of the orifice, a cyst is formed. Such a case was observed by Lloyd, in the region of the saphenous vein, and was described by Paget.[1] A somewhat similar case was examined by Virchow.[2] In this instance the disease was complicated by cancer, and the cyst developed from the internal jugular vein, where no communication with the vein could be found. Hæmato-cysts resemble the serous cysts in every particular, with the exception of the presence of blood in their contents. Their diagnosis, however, is more difficult, and should always be made by exclusion, due attention being given to the location of the cyst, time of development, and character of contents.

Branchial cysts of the neck, as compared with other tumors in this locality, are of rare occurrence. The statistics of branchial tumors cannot be relied upon in estimating the comparative frequency with which these tumors occur, as many branchial cysts have been classified and described under the generic and indefinite term "Cystic tumors of the neck," without regard to their etiology. Gurlt,[3] in 1855, compiled 44 cases of serous, and 6 cases of atheromatous cysts. Since that time quite a number of new cases have been described by Volkmann, Billroth, Esmarch, Roser, Langenbeck, Luecke, and Burow. The serous variety is more likely to develop early;

[1] Lectures on Surgical Pathology, 1853, vol. ii, p. 50.
[2] Die Krankhaften Geschwülste, vol. i.
[3] *Archiv für Klin. Chirurgie*, vol. xiv.

they are often congenital, or appear during infancy or childhood, while the atheromatous cysts are most frequently met with in young adults. Of 53 cases mentioned by Schede[1]

9	occurred	between	the	1st	and	10th	year of life.
21	"	"	"	11th	"	20th	" "
10	"	"	"	21st	"	30th	" "
6	"	"	"	31st	"	40th	" "
5	"	"	"	41st	"	50th	" "
2	"	"	"	51st	"	60th	" "

Like the dermoid cysts, the branchial tumors show a tendency to develop during the period of puberty, at a time when the epiblast enters upon a new phasis of development, and becomes the seat of renewed and active tissue proliferation. The remnants of the branchial cleft may remain dormant as a matrix for the future growth of the tumor for an indefinite period of time, and become the seat of tissue growth during puberty, or upon the advent of any determining cause or causes. There are undoubtedly many instances where remnants of fœtal tissue remain latent in the branchial tracts throughout a lifetime for want of an adequate exciting cause, which is necessary to call into morbid activity the slumbering forces inherent in the histological elements of the matrix.

Diagnosis. To diagnose the presence of a branchial cyst, is often no easy task. The importance of the tissues and organs which are in close and intimate relation with these tumors, renders it imperative upon the surgeon to make a correct diagnosis before an operation is undertaken for their removal. All witnesses should be examined carefully, and every diagnosis should be fortified by eliminating the existence of all other forms of tumors. The following conditions may simulate a branchial cyst: 1, Aneurism; 2, angioma; 3, dermoid cyst; 4, retention

[1] Die Cystengeschwülste des Halses. Berlin, 1855.

cysts; 5, affections of lymphatic vessels and glands; 6, struma cystica; 7, simple serous cyst.

1. *Aneurism.* As most of the branchial cysts are in immediate contact with the large cervical vessels and usually receive the impulse from the underlying artery, it is always important to exclude the possible presence of an aneurism. At the age when branchial cysts are most frequent, aneurisms, except of traumatic origin, are exceedingly rare. Pressure does not affect the volume of a branchial cyst, and the pulsations are felt only in one direction, away from the artery. Auscultation furnishes another important negative symptom. An exploratory puncture, which should always be made in doubtful cases, will also furnish valuable information, as it will afford an opportunity to examine the contents of the cyst under the microscope, and such examination will not only help to substantiate the diagnosis, but, in many instances, will by itself be sufficient to arrive at positive conclusions. In hæmatocysts, the contents may resemble venous blood, but a microscopical examination will show in addition the presence of epithelium or the products of epithelial degeneration.

2. *Angioma.* Deep-seated angiomata of the neck are occasionally met with in children, and as the skin may present a perfectly natural appearance they might be mistaken for a branchial cyst. If the tumor disappears under pressure, it may be an angioma, but never a branchial cyst.

3. *Dermoid cyst.* As dermoid cysts may occur in the same localities, and at the same age, they are frequently mistaken for branchial cysts, and *vice versa*. A number of authors classify deep-seated atheromatous cysts with dermoid cysts. As both varieties of cysts require the same treatment, a positive diagnosis is not essential. A correct anatomical diagnosis can be made by examining the contents and the cyst walls. A branchial cyst contains only one constant histolog-

ical element—epithelium, as obliteration of the branchial tracts takes place long before the appendages of the skin are developed. A dermoid cyst, on the other hand, as its name implies, contains the products of secretion of the skin and the organs which it contains, the hair follicles, the sweat, and sebaceous glands. Lanuginose hair and hair follicles are never present in a true branchial cyst, while they are frequently found in the contents of dermoids. The walls of a branchial cyst are composed of a connective tissue capsule lined with epithelium, while on the other hand, the sac of a dermoid cyst is composed of true skin.

4. *Retention cysts.* The only two forms of retention cysts which call for consideration in this connection are the true atheroma of the skin, the result of obstruction in the ducts of the sebaceous glands and the retro-tracheal cyst, which originates in a similar manner in the retro-tracheal glands. Cysts arising from the second and third branchial clefts are always deeply located, and when first observed are distant from the skin, while an atheroma primarily develops in the skin, and usually grows in a peripheral direction. Branchial cysts are always congenital, atheromatous cysts acquired. Lanuginose hair is sometimes found in the contents of an atheroma, the product of retained hair-follicles; it is never seen in branchial cysts. Another important anatomical difference will be found in the outer portion of the capsule of the cyst and its relation to the surrounding tissues. In branchial cysts the capsule is quite vascular, and intimately connected with the adjacent structures, the reverse being true of the retention cysts.

Virchow[1] has called attention to a peculiar kind of retention cyst between the œsophagus and the trachea arising from an obstruction in the duct of one of the retro-tracheal glands. These glands are situated

[1]Die Krankhaften Geschwülste. Berlin, 1863. Vol. i, p. 246.

between the trachea and the œsophagus, but their ducts traverse the entire thickness of the tracheal wall and terminate upon the free surface of the mucous membrane. These cysts are so located that they give rise to distressing symptoms referable to deglutition and respiration before they attain any considerable size, and before their existence is suspected or detection is possible, differing greatly in this respect from the clinical history of a branchial cyst.

5. *Affections of lymphatic vessels and glands.* A deep-seated isolated caseous lymphatic gland might be easily mistaken for a branchial cyst, more particularly after the cyst had become the seat of inflammatory infiltration. Luecke[1] claims that he has observed the development of dermoid cysts within lymphatic glands. It is seldom that we meet any such extensive pathological changes in a single lymphatic gland to such a degree as to simulate a branchial cyst, without participation of one or more adjacent glands. Again, in cases of disease of the lymphatics the general condition of the patient usually indicates the existence of a serious affection, while a branchial cyst is a purely local condition, never affecting the general health of the patient, except when by compression it interferes with important functions of neighboring organs. Köster is of the opinion that many of the multilocular cysts of the neck are the result of lymphangiectasis, but in such cases a microscopical examination would show the presence of endothelia which would exclude the branchial origin of the tumor. Cancerous or sarcomatous affections of the lymphatic glands would reveal themselves by the clinical symptoms characteristic of these tumors.

6. *Struma cystica.* Cystic degeneration of the thyroid gland proper can never be mistaken for a branchial cyst, as the connection of such cysts with

[1] Die Lehre von den Geschwülsten. Pitha u. Billroth's Handb. d. allg. u. op. Chir. Vol. ii, p. ii, p. 127.

the thyroid body can be traced without any difficulty, but recently it has been ascertained that not infrequently small accessory thyroid glands exist in the neck which may undergo cystic degeneration, and Madelung has made the assertion that the so-called hydrocele of the neck is only a struma cystica of a supernumerary thyroid gland. The possibility of a cystic degeneration of such an accessory thyroid body should always be borne in mind in all examinations for branchial cysts.

7. *Simple serous cysts.* Virchow asserts that many of the serous cysts develop without a particular matrix, as new formations in the connective tissue. It is a well-known physiological fact that the connective tissue cells are occasionally converted into endothelia, as during the formation of new synovial membranes, hence we should *a priori* expect that in simple serous cysts developed from connective tissue the inner surface of the sac would be lined with endothelia, the existence of which would be sufficient to disprove their branchial origin.

Cystic degeneration of the ganglion caroticum has been supposed to resemble branchial cysts. Luschka[1] has described a ductless gland between the external and internal carotid arteries, near the bifurcation of the common carotid, to which he has applied the term ganglion caroticum. As this gland is located where branchial cysts usually are found, he has made the assertion that many of the cysts in this region are due to a cystic degeneration of this gland. To cysts originating in this manner he has applied the term *hygroma colli.* The researches of Julius Arnold, however, do not corroborate the observations of Luschka, and Virchow positively denies the glandular nature of this body.

In repetition I will enumerate the following points,

[1] Virchow. Op. cit. vol. iii, p. 93.

which should be considered in the differential diagnosis of cystic tumors of the neck and with special reference to branchial cysts: 1. Primary seat of tumor. 2. Effect of pressure. 3. General condition and age of patient. 4. Character of contents.

Prognosis. Branchial cysts, although heterologous formations, always remain purely local affections and manifest no tendency to destroy life, except when they are of sufficient size to interfere by their presence with the performance of important functions of neighboring organs. On the other hand, it may be said that they manifest no tendency to spontaneous cure and prove exceedingly rebellious to all forms of treatment short of complete extirpation. The serous variety in exceptional cases may undergo spontaneous absorption, and, as a rule, is most amenable to the milder forms of treatment. After the development of these tumors, their further growth may become stationary for a short time, but their tendency is to increase in size until they encroach upon important organs, when the suffering and distress which they occasion call for decided and effective operative measures for their removal.

Treatment. The inner surface of branchial cysts being lined with epithelium, it is evident that obliteration of the sac can only be obtained after the destruction or removal of this epidermal lining. The radical treatment for the removal of these tumors must have for its object the production of an artificial inflammation in the interior of the sac of sufficient intensity to destroy the epidermal matrix, or complete extirpation of the cyst. The former procedure is exceedingly unreliable in its results, and extirpation in many instances must be looked upon as a very formidable and dangerous operation. The following methods have been resorted to in the treatment of branchial cysts: 1. Incision. 2. Actual cautery. 3. Seton. 4.

Puncture with subsequent injection. 5. Extirpation. 6. Antiseptic drainage.

1. *Incision.* In all cases where incision was practiced, the relief from existing symptoms was prompt; the cyst collapsed, a certain amount of inflammation was established, suppuration followed, and, in some instances, the patient and surgeon were led to believe that a radical cure was obtained. Usually after healing of the wound a small nodule remained, which in a few months again became the seat of active tissue growth, and a speedy relapse was an almost constant occurrence. The result was not materially modified in case the sac was drained and injected with iodine or other irritating solutions. In infants the laying open of cysts is a perilous plan of treatment. Volkers relates a case where a cystic tumor was laid open in a new-born child who died 16 days afterward in consequence of the operation. A branchial cyst cured by simple incision is reported by Billroth. In the case of serous cysts where the seton and iodine injections have occasionally been successful in producing obliteration, it seems to me that the same object would be accomplished more speedily and safely by incision and drainage, practiced in a similar manner as in Volkmann's operation for hydrocele.

2. *Actual cautery.* Dieffenbach employed the actual cautery in opening the cyst in one of his cases after he had made an unsuccessful attempt in removing it by extirpation, and after incision had failed in producing obliteration of the sac. The use of the cautery met with no more encouraging result. It would seem to me that incision combined with an energetic use of the cautery would be most applicable in the most dangerous and formidable class of cases, namely, in cysts which have become firmly adherent to the sheath of the cervical vessels by repeated attacks of inflammation. Should I ever meet with a similar case as the one reported in this paper, where

the internal jugular vein was injured, I should make a free incision into the cyst, and after removing as much of the sac as would be compatible with safety and after exposing to sight the floor of the cyst, I should destroy the entire epidermal matrix of the attached portion with a Paquelin cautery. The wound could be sutured and dressed the same as after excision, by which primary union of the wound with complete destruction of the matrix of the tumor could be secured, without exposing the patient to the much greater risk of injury to the internal jugular vein which would be incurred by attempting complete extirpation.

3. *Seton.* This form of treatment proved successful in several of Thos. Smith's cases of serous cysts of the neck, but in some of them the branchial origin of the cysts does not appear to be established. Smith[1] uses a single thread of silk, and removes it before suppuration sets in. If the tumor is polycystic, he attacks only one cyst at a time. Gurlt very justly has entered his protest against the use of the seton. Like in hydrocele, the seton is an exceedingly uncertain agent in calculating with precision the amount of inflammatory action which will follow its use. The degree of irritation produced by it is very liable to be inadequate to produce adhesion, or it exceeds the desirable boundary and induces suppuration with all its evil consequences. Even the seton is not devoid of danger. Butlin reports the case of a young child where a seton was passed through a serous tumor, and which was followed by death on the third day from the violence of the inflammation.[2] For this and other obvious reasons the seton should never be used in the treatment of branchial cysts.

4. *Puncture with subsequent injection.* In the transactions of the fourth Congress of German Sur-

[1]Op. cit.

[2]International Encyclop. of Surgery, New York, 1884. Vol. iv, p. 663.

geons the treatment of branchial cysts by puncture and injection was fully discussed.[1] Esmarch's experience appeared to be the most extensive, and his results were more uniformly favorable than in the practice of any other surgeon. The following are some of Esmarch's remarks on this subject:[2]

"I have cured about a dozen cases by puncture and subsequent injection of Lugol's solution of iodine. (Iodinii, pot. iod. āā 1.25, aquæ 30.c). Against this treatment it has been urged that complete extirpation of the cyst can always be done and is free from danger I must deny this assertion, because in a majority of cases the cyst is adherent to the sheath of the internal jugular vein, a fact which may remind you of a paper on this subject by Prof. von Langenbeck, which served as an introductory to his Archiv in 1860. In this paper Langenbeck called special attention to the dangers connected with this operation. But even if the operation were free from danger, yet by resorting to it we obtain an unsightly cicatrix in the neck, to which the female sex objects. I can, on the other hand, recommend injections of iodine as an efficacious and entirely safe procedure. If some of you have failed to see its benefits, it is, I believe, because you have not had the necessary patience and perseverance. As a rule, I have repeated the operation whenever obliteration did not promptly follow the first puncture. It is very essential to irrigate the sac thoroughly before the introduction of the iodine. I have generally proceeded as follows: By means of a fine hydrocele trocar I empty the sac of its contents, and then make repeated injections of a one per cent. solution of carbolic acid. This removes the masses of epithelium adherent to the cyst-wall. I continue these injections until the water returns perfectly clear, and then I inject 10–20 grms. of Lugol's

[1] Verhandl. der deutschen Gesellschaft f. Chirurgie, 1876, p. 25.
[2] Op. cit., p. 229.

solution of iodine, which, after gentle pressure to bring it in contact with the inner surface of the sac, is allowed to escape. The patient is then directed to return in six or eight weeks. Like a hydrocele, the cyst refills rapidly and becomes somewhat painful. If, after the lapse of time mentioned, it has not greatly decreased in size, I repeat the same operation, and tell the patient to return in six months, when the cyst will be found atrophied to a small tubercle. In most cases the cure has been permanent."

In the discussion which followed, Langenbeck said: "I have treated a number of dermoid cysts with fatty contents by means of injections of iodine, but the injections always required repetition. I punctured the cyst with a large trocar, introduced a piece of elastic catheter and made daily injections. A few cases were cured after three or four injections. In one case the tumor returned. I consider it very difficult to cure these fatty cysts with injections of iodine or any other substance."

Roser admitted that injections of iodine might succeed in serous and mucous cysts, but that they would prove of no avail in atheromatous cysts. Baum asserted that extirpation was an easy matter, and that these cysts could be removed without difficulty.

Bardeleben believed that some of these cysts, especially those which extend behind the sternum, could not be extirpated, but obliteration in one instance was accomplished by antiseptic drainage. Volkmann spoke in favor of extirpation and warned against injections of iodine, as in case of failure they would render a subsequent excision more difficult.

It is evident that the majority of German surgeons who have given a good deal of attention to this subject have no confidence in the efficacy of iodine injections in obliterating branchial cysts. If we consider the numerous failures of iodine injections in cases of hydrocele, where the anatomical conditions for success

are so much more favorable, we will be better prepared to appreciate the causes of its still more frequent failures when used in the treatment of branchial cysts. Again, clinical experience has shown that branchial cysts can be extirpated with comparative ease and safety before the cyst has become firmly fixed to the subjacent cervical vessels by inflammatory infiltration and that in this class of cases iodine or any other injections will not only prove useless, but will render a subsequent extirpation still more difficult. In infants even simple tapping is not always devoid of danger, as one instance is recorded of death caused by puncture. The case occurred to Volkers, who tapped a cystic cervical tumor in an infant eight days old, the child dying of trismus on the third day.[1]

5. *Extirpation.* A positive diagnosis made, the best plan to pursue is to make an incision over the most prominent portion of the tumor, and, in case the adhesions can be separated without endangering the deep cervical vessels, the entire cyst should be removed. If inflammatory infiltrations obscure the field of operation at the base of the tumor, and after careful examination it is not deemed advisable to perform complete extirpation, the sac should be opened and the lateral walls excised, and the epidermal matrix, which remains adherent to the sheath of the cervical vessels, can be destroyed completely by a careful but vigorous use of the actual cautery. The treatment of the wound should be conducted as in cases of complete excision. If an early diagnosis is made, and prompt treatment instituted, complete extirpation should always be attempted, and will in the majority of cases prove successful and comparatively free from danger.

6. *Antiseptic drainage.* In the case of infants and very young children suffering from large serous cysts,

[1]Dr. Storch, Ueber das angeborene Hygrom des Halses. *Journal für Kinderkrankheiten.* Vol. xxxvii, p. 68.

it would be imprudent to resort to any of the severer measures with a view to a radical cure. In such instances, drainage under antiseptic precautions should be resorted to as a temporary measure, and in some instances it may be followed by permanent results. The same course of treatment should be adopted in adults suffering from cysts which are inaccessible to any other operation, and in which irritating injections are contra-indicated.